



## New mathematical tools contribute to development of healthier seafood products

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**New mathematical tools** contribute to development of healthier seafood products

# Putting math to food use

A recently completed Danish project with focus on salt reduction has developed new and comprehensive mathematical models and software to predict how growth of undesirable microorganisms can be controlled in seafood products. These tools have contributed to a new series of Nordic Keyhole-labeled seafood products from Royal Greenland with less salt, a more natural taste and higher food safety.

The dietary recommendations from the Danish Veterinary and Food Administration indicate that Danes should eat more fish and less salt. Intake of more fish and less salt will reduce the risk of cardiovascular diseases, as well as bringing other health benefits. It is estimated that reducing salt intake by 3 g/day per person on average will result in an annual saving of EUR 130-260 million in health care costs in Denmark. Similarly, in other Scandinavian countries there has been significant focus on producing in accordance with the Nordic Keyhole label, where less salt is one of the primary goals. However, this represent a challenge for seafood companies and particularly for those producing lightly-preserved seafood including smoked and marinated fish, shellfish in brine, and pasteurized lumpfish roe with

a relatively long shelf life, when refrigerated.

The challenge is that less salt allows both pathogenic microorganisms such as *Listeria monocytogenes* and *Clostridium botulinum* as well as spoilage microorganisms such as *Pseudomonas* and lactic acid bacteria to grow better and potentially reach critical concentrations in the products. The purpose of the project "Developing seafood products with improved health value, food quality and food safety (LOW SALT)" within the Danish Green Development and Demonstration Program (GUDP) was therefore to develop new predictive models and software to be able to predict how the composition of seafood can be modified to achieve products with reduced salt content. This 4-year GUDP project, which was completed in December 2017,



has been carried out by the National Food Institute (DTU Food) at the Technical University of Denmark (DTU) in close cooperation with Royal Greenland Seafood A/S.

## The Nordic Keyhole label



® The Nordic Keyhole is the official nutrition label of the Nordic Council of Ministers and it is intended to alert consumers to healthier choices when shopping, eating out, or following recipes. Food, menu items, and recipes labelled with the Nordic Keyhole must meet specific requirements

regarding fat, sugar, salt and dietary fiber content. The Nordic Keyhole label makes it easier to choose healthier products and comply with official dietary recommendations. On September 1, 2016, the requirements for the Nordic Keyhole label became more restrictive. Smoked and marinated fish as well as caviar and other lightly preserved seafood must contain no more than 3.0% salt. Delicatessen products (e.g. fish cakes) must contain no more than 2.5% salt, whereas other seafood products including brined shellfish must contain no more than 1.5% salt.

## Development of new predictive models and software

Predictive models and software can predict the growth and survival of microorganisms in foods. Predictions are used to



The new lightly preserved seafood products from Royal Greenland with the Nordic Keyhole label.

determine food safety and shelf life, depending on the product characteristics, and storage and distribution conditions. The use of predictive models and software for food safety documentation is supported by the EU legislation (EC 2073/2005) as well as by recommendations from the Danish Veterinary and Food Administration ([www.foedevarestyrelsen.dk](http://www.foedevarestyrelsen.dk)).

Within the LOW SALT project, DTU Food has developed new and comprehensive predictive models for psychrotolerant, i.e. able to grow at low temperatures, *Clostridium botulinum* and *Pseudomonas* bacteria. These models are particularly relevant for seafood products with reduced salt content, as salt is specifically used in lightly preserved seafood products to prevent the growth of psychrotolerant *Clostridium botulinum*. The new models can be used together with existing and popular predictive models for *Listeria monocytogenes* and lactic acid bacteria. This



is of great practical importance in product development, where predictions make it possible to formulate recipes with reduced salt and at the same time compensate for the lost effect of salt on preservation through targeted change of other product properties. As examples, such changes could be addition of alternative preservatives and/or a reduction of pH. In this way, the use of predictive models and software contributes to faster, better and cheaper product development, as it would be costly and time consuming to obtain the same information from product trials.

## Development of new seafood products at Royal Greenland



During the project period, Royal Greenland developed 37 new lightly preserved

seafood products with the Nordic Keyhole label, including 25 smoked/marinated products. In 2017, four new products of pasteurized lumpfish roe were launched with less than 3.0% salt compared to the usual salt content of approximately 4.5%, corresponding to a reduction of more than 30%. Both taste and healthfulness of the Nordic Keyhole-labeled roe products were significantly improved.

Royal Greenland has also launched eight new Nordic Keyhole-labeled products of cold-water prawns in brine. The salt content of these newly developed brine products is below 1.5%, compared to the usual 2.0-3.0%, representing a reduction of 25-50% salt. Expressed in another way, the total amount of prawns made by Royal Greenland in 2017 contained eight tons less salt than just a few years ago. The new products taste fresh, more natural and have a far more unique and authentic prawn taste than the "traditional" cold-water prawns in

brine, which often contain more than 3.0% salt.

The successful launch by Royal Greenland of these new high-quality products with lower salt content and improved taste and food safety has been facilitated by the development of two new predictive models for psychrotolerant *Clostridium botulinum* and *Pseudomonas*. In practice, the models mean that Royal Greenland has become much more innovative and effective in the development of recipes for low-salt seafood products without compromising either taste or food safety.

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## Food Spoilage and Safety Predictor

### A tool to forecast the growth of microorganisms



The Food Spoilage and Safety Predictor (FSSP) program contains mathematical models that can predict the growth of both pathogenic and spoilage microorganisms. FSSP is used by more than 10,000 people from companies, institutions and authorities in more than 100 different countries. FSSP was developed by Professor Paw Dalgaard at DTU Food and is freely available from <http://fssp.food.dtu.dk>. The program was introduced in 1999 and version 4.5 will be released during 2018.